

# Rebuilding after the Tsunami: Getting It Right

The practice of integrated coastal management (ICM) has matured sufficiently since its beginnings in the early 1980s to suggest a set of principles that could be used to guide the massive investments that will be made over the next several years to rehabilitate and reconstruct the thousands of kilometers of coastlines devastated by the 26 December 2004 tsunami. We offer six principles to guide what can be done to make coastal communities less vulnerable, to improve the conditions of the poor, and to avoid repeating the mistaken judgements that have been made in the past about how shorelines are allocated and developed. We then offer a set of five principles to guide how action plans are formulated and implemented. These stress the critical importance of tailoring principles to the unique conditions and needs of each place. The roles of national government in setting policies to guide a decentralized planning and decision-making process are distinguished from a negotiation process that engages the people of the place in a bottom-up application of ICM good practices.

## THE SOCIAL AND ENVIRONMENTAL IMPACTS OF THE 26 DECEMBER 2004 TSUNAMI

On Sunday, 26 December 2004, at 12:59 a.m. GMT, the fourth largest earthquake in the world since the year 1900 struck off the coast of Sumatra (1, 2). The quake unleashed terrifying tsunamis that raced across the open ocean, wreaking destruction on coastal communities in more than a dozen countries, all the way from Southern Asia to East Africa. Just half an hour after the quake, the waves wiped away entire villages on the Sumatran shore. The Tsunami tore through coastal areas of Sri Lanka 3 hours later, killing over 30 000 people, destroying over half of the country's fishing fleet, and crushing industrial infrastructure along the coasts (2). The waters ravaged the coasts of India, Thailand, Malaysia, Myanmar, and the Maldives, wiping out all structures in a band that was in some places several city blocks deep. The devastation was not yet done. Kenya, Somalia, and Tanzania would suffer the wave's effects. Within a few catastrophic hours, the Tsunami caused more casualties than any other wave in recorded history, killing over 250 000, and leaving an estimated 1 126 900 people homeless (1, 2).

## THE OPPORTUNITIES WITHIN THE DISASTER

In our collective desire to respond to the death, pain, and suffering unleashed by the 26 December tsunami, we risk missing an opportunity as big and as rare as the tsunami itself. We can rebuild these areas the way they were and repeat the mistakes of the past, or we can apply what we know about how coastlines change in response to human and natural forces, and create safer and more economically viable communities.

The rehabilitation, for which nearly US\$6 billion (3) has been allocated, must draw upon the vast experience of scores of projects and programs undertaken in the region and around the world over the past three decades (4). Under the umbrella concept of ICM, these projects and programs show how much can be done through a cooperative process that engages the

public, applies the science of how coastal systems work, and is adaptive to changes in conditions (5–8). Governments and international organizations engaged in rebuilding need to agree to a simple set of common principles based on the ICM experience—what to do and how to do it. If they do this before the reconstruction begins, the positive impact on the lives of millions of surviving coastal dwellers and future generations could be as great or greater than the benefits of an early warning system for future tsunamis, and it would complement the heroic efforts of all those who have risen to meet immediate humanitarian needs.

If the rehabilitation follows the business-as-usual pattern of disconnected projects and uncoordinated programs, the funds will be spent to recreate the unsustainable and inequitable conditions that prevailed before the tsunami struck. The poor will again be pushed into the most unhealthy and hazardous areas of the coast. Development patterns will be inefficient, inequitable, and increasingly unsustainable. The predictable result is the long-term breakdown of ecological resilience brought on by the destruction of estuaries and wetlands, declining water quality, collapsing fisheries, and loss of access to the shore and its resources for the majority of residents. These are conditions that have contributed to the social unrest that has plagued Sri Lanka and Aceh.

The ICM alternative emerged in the 1980s after a great deal of trial and error, and has become the most widely recommended response to the forces of ecosystem change in coastal regions (9–13). The emphasis on integration is essential. High population densities and the superimposition of competing activities in dynamic coastal systems require linking ecology with economics. To these must be added an understanding of how different cultures define their goals and implement plans of action. ICM works to reduce risk from natural hazards, and to avoid making people, property, and public investment vulnerable to those hazards. In effect, it works to make adaptive ecosystem management an operational reality (14–17).

In many places, the immense forces driving coastal systems are not understood and the rule of law is weak. Where poverty prevails and development proceeds through a multitude of individual decisions based on short-term economic gain, a more holistic approach is seen as too complex, too lengthy, and too expensive. ICM programs can overcome these conditions through the meaningful participation of those affected in a plan of action, with fair dealing and accountability and the application of the best available science.

Although it is essential for the desired outcomes of an ICM program to be endorsed at the highest levels of government, the bulk of the planning and decision-making occurs place-by-place and engages those affected. We propose a simple set of principles to guide *what* is done and then suggest the process for *how* the principles are applied.

## SIX PRINCIPLES TO GUIDE WHAT IS DONE

1. Respect the powerful and often unpredictable natural forces that drive local systems.
2. Reduce the exposure of coastal communities and coastal activities to natural hazards.
3. Allow natural systems to protect people and generate a diversity of sustainable livelihoods.

4. Correct past mistakes and inequities in the design and placement of public services.
5. Avoid increases in fishing power.
6. Promote diversified livelihoods that reduce poverty and the destruction of coastal ecosystems.

### **Respect Natural Forces**

It is not possible to sustain any development in coastal areas if the huge energy and natural dynamics of coastal systems are ignored. Many of the adverse social and economic impacts of the tsunami have occurred because people have been made more vulnerable to natural hazards through poor planning and the ineffective management of development. The technical difficulties and financial costs of fighting against the natural dynamics of coastal systems far outweigh the long-term benefits that can be gained by working with the natural processes that create and maintain healthy ecosystems and a flow of social and economic benefits to mankind.

### **Reduce Human Exposure**

The immediate priority is to define the construction setback lines that, if enforced, are often the most effective single action for making restored coastal communities safe from future natural disasters. In Sri Lanka, a presidential edict issued in the days following the disaster calls for a 100-meter construction setback along the crowded southwest coast and a 200-meter setback on the more rural southeast. As yet, there is no clear process for adapting these declarations to local conditions. In Thailand, the Governor of Phuket has proclaimed a 100-meter setback and the Governor of neighboring Krabi Province has halted all reconstruction of very popular resorts on Phi Phi Island until setbacks have been defined. In places, the politically powerful, impatient of any delay, are ignoring such declarations and rebuilding while the poor wait in emergency shelters.

Timely application of what is known about past and future coastal change can be applied to quickly define the setback lines. For example, detailed aerial photographs could be prepared reach by reach showing conditions as they were before and after the tsunami. Lines could be drawn on each map showing the mean high water mark anticipated by the 2050 median projection for a sea level rise of the Intergovernmental Panel on Climate Change. This could be augmented with additional data where it exists. The anticipated effect of historical trends in erosion and accretion to 2050 and the inland extent of flooding in past storms could also be mapped. A recommended construction setback line could be set by each government as a set distance inland of the anticipated shoreline predicted by these variables. The width of the no-build zone can and should be greater in as-yet-undeveloped shores than along already urbanized areas. Such an approach would have to provide for on-site consultations governed by clear standards that permit the recommended setback to be adapted to local conditions and local needs. Once refined through on-site consultations, the setback line should be clearly identified with permanent on-site markers. The expertise to do this efficiently is present in each country.

All investments in government infrastructure, including roads and utilities, should be kept behind the setback line. Exceptions to allow structures seaward of the setback line should be approved only where they are required to support such water-dependent activities as fishing and navigation. Permanent settlements and tourist facilities should not be allowed under any exception, because they need not and should not expose people within the danger zone. Where exceptions are granted, all structures should be either temporary or built to

withstand projected flooding—for example, by strengthened structural members and elevated first floors. In places where risks of storms and flooding are known to be high, it is prudent to construct safe shelters for the population to use in times of storms and other hazards.

A feature critical to the successful practice of coastal management is the ability to tailor principles to the unique needs and conditions present in a specific locale. For example, on low-lying shorelands like those in Bangladesh and the Maldives, a construction setback may not be effective in reducing the vulnerability of people to rising sea level, waves, and flooding. In such places, focusing on building cyclone shelters and community-based emergency plans is the best approach. However, in most situations, relocating damaged roads, railroads and dwellings to higher ground is both feasible and sensible.

### **Allow Natural Systems to Work**

Natural barriers to flooding and coastal erosion, such as coral reefs, nearshore rock outcrops, sand bars, and sand dunes should be protected from construction activity and from uses that compromise their structural integrity. They reduce, absorb, and redirect storm effects. Wetlands, lagoons, river estuaries, and reefs are essential to sustaining fisheries, public health, and the many livelihoods that support coastal populations. They contribute to a healthy and aesthetically pleasing environment for a seaside holiday. A portion of the funds for rehabilitation should therefore be assigned to protect and restore these habitats. Maps used for establishing setback lines can be used to consult with locals to identify natural features as they existed before the tsunami and help define restoration projects.

Reconstruction will require thousands of cubic meters of sand for cement and for fill, as well as building materials of every description. Traditionally, most of these materials have been taken from the coast itself, weakening the natural resiliency of the resources. Sand is mined from beaches, dunes and coastal rivers; mangroves provide timber, and wetlands are filled as building sites. This makes coastal settlements more vulnerable to natural events. The removal of corals around the Maldives has made coastal communities more exposed to wave action from storms and tsunamis. In Sri Lanka, sand is mined from riverbeds under a permit system. Mining sand from beaches and breaking coral reefs to supply kilns that produce lime has, after a long campaign, been brought under control. More recently, seagoing dredgers have been contracted to haul in sand for eroding beaches.

A protracted period of reconstruction without controls on these kinds of actions will destabilize coastlines and make the new communities being built more vulnerable to storms and natural processes of erosion and accretion than before. Mining of sand, coral, and stone from the shore and in coastal waters within the 20-meter depth contour must be prohibited, and sand mining from rivers should be strictly regulated. Wetlands and mangroves should be off limits for harvest of wood or filling for building sites.

Finally, there will be many calls to try to use traditional engineering methods to control coastal erosion. These should be resisted, with erosion control projects limited to those situations in which there is no viable alternative for protecting preexisting infrastructure or settlements, and in which the benefits can be sustained over time. In such cases, soft solutions such as placement of sand or planting vegetation should be favored over hardening with breakwaters, groins, shoreline armoring, etc.

### **Improve Public Services**

Implementing the first two principles will at times be unpopular. Yet a balanced tough-love strategy, fairly implemented, will win

support. The reconstruction provides an unprecedented opportunity to relocate communities away from hazardous and unhealthy areas, rectify badly designed infrastructure and services, and reduce previous inequities in their availability and distribution. It will be essential to negotiate such resettlement with the communities affected, to provide compensation to those who lose their property, and above all to confirm that such action is in the best long-term interest of those affected. The objective should be to provide safe drinking water, adequate sewage collection and treatment, and needed drainage systems to all communities, regardless of economic level or social group. Preference should be given to standardized, modular systems with interchangeable components to achieve cost savings and reduce future maintenance costs.

Along developed shores—especially where tourism hotels have become dominant—a major issue for long-term residents is public access to the shore for fishing and other traditional activities. As part of the reconstruction, rights-of-way to the shore should be identified with permanent on-site markers and made available for unrestricted public use. In communities with traditional fishing activity, landing sites and facilities for cleaning catches and storing fishing gear should be restored or relocated to an equivalent or better site with ready access. In addition, religious and cultural sites along the shoreline that are valued by local residents should be identified and preserved.

### **Avoid Increases in Fishing Power**

Many of the poor who live along the shore rely on fishing for their livelihoods. For them, the tsunami has been devastating, destroying their boats and gear and reshaping landing sites and channels to the sea. Competition was already fierce between the artisanal fishers who work from small boats and the industrial fisheries that use large motorized vessels, often with salaried crews. Between them, the fishing power before the tsunami had long outstripped the regenerative capacity of the fisheries, down to depths of 100 meters in places. This led to use of increasingly destructive methods, including poisons and dynamite in some areas. It would be an economic and ecological disaster if well-intentioned restoration efforts resulted in replacing vessels and gear in ways that increase the pressure on already overfished coastal waters.

### **Promote Diversified and Sustainable Livelihoods**

The rehabilitation of hundreds of kilometers of shoreline—and more than 500 villages along the east coast of the Andaman Sea alone—is a golden opportunity for encouraging an advance to diversified and more sustainable livelihoods. For example, community-based aquaculture and tourism that maximize benefits to local populations and do not degrade coastal ecosystems are real alternatives in some areas. There are ways to rectify the damage and conflicts brought by high production shrimp aquaculture operations. Where shrimp ponds are rebuilt, they should be subject to siting criteria that protect natural systems and coastal water quality and limit the intensity and extent of operations in each coastal reach.

## **FIVE PRINCIPLES TO GUIDE HOW THE REHABILITATION PROGRAM IS IMPLEMENTED**

1. Secure commitments from governments and international organizations to abide by a common set of clear principles regarding what is to be done.
2. Establish within each national government clear goals that define the social and environmental outcomes that will result from the reconstruction.

3. Decentralize detailed planning and decision making so that those affected can meaningfully participate and shape the outcomes.
4. Celebrate successes and disseminate the lessons across the region as they emerge from the rehabilitation process.
5. Adopt mechanisms that promote accountability and acknowledge the failures as well as the successes.

### **Secure Commitments**

Time is of the essence. Within six weeks of the tsunami, there were full-page ads in Western newspapers inviting tourists back to rebuilt resorts. The first step is for the governments of each affected country and the supporting international organizations to endorse these or similar principles and to enunciate their implications for reconstruction activities. Each nation's approach to carrying out the principles will vary to reflect its traditions and cultures, but the principles themselves are universal. The adoption of the principles need not add time to the reconstruction process. In fact, if unequivocally endorsed by the highest levels, the principles will reduce uncertainty and reduce the wait for decisions.

### **Establish Clear Goals**

Each participating nation and its partner organizations should adopt a set of specific, measurable goals for the reconstruction. These will help focus the effort and provide a basis for measuring successful implementation of the principles. Examples might be to double the number of people with potable water over pretsunami levels or to require the construction of modular sewage treatment facilities for all communities over a certain size.

### **Decentralize Decisions**

To be consistent with the principles and national goals, a structure for carrying out the reconstruction requires a decentralized approach that encourages the active participation of those most affected by the reconstruction process. Local government and the public must play a meaningful role in specific reconstruction decisions, reach by reach along the coast. This should be seen as a bargaining process involving all affected parties and interests. Local knowledge combined with technical expertise operating under national goals and science-based principles is the recipe for success. The issue in each country is whether this coalition will be engaged and permitted to carry the day, or whether the principles and goals will be compromised by the old ways of doing business.

### **Celebrate Success**

Any process as large and complex as the tsunami reconstruction will be a source of learning and advancement. But it will also be susceptible to corruption, incompetence, and foot-dragging. Nothing quite like it has been attempted before, and it will be important to learn and adjust as the effort unfolds. Incentives need to encourage transparency and make those responsible accountable for their actions. It will be important to recognize and celebrate successes, and to have ways of communicating lessons learned to the region. This could be a key role for international organizations.

### **Promote Accountability**

At the same time, there must be a way to judge the performance of each nation as the massive reconstruction effort unfolds. There will be successes and lessons learned, but there will also



be failures and errors committed. Although nations and international organizations are good at communicating the former, they often avoid the latter. To fill this gap, we propose that an international panel of experts from the region and throughout the world be assembled annually to review progress toward the achievement of the principles and the national reconstruction goals of each affected country. The panel would issue an annual "Report Card to the World" on the outcomes of the reconstruction process. The Report Card would highlight each country's successes, document problems encountered, and evaluate mistakes that have been made. This would provide for a measure of accountability while encouraging collaborative learning and the broader dissemination of good practices.

## INITIAL RESPONSES TO RECONSTRUCTION PRINCIPLES

To guide the reconstruction effort, the United Nations Environment Program (UNEP) Tsunami Disaster Task Force convened a meeting on coastal zone rehabilitation and management in the tsunami affected region on 17 February 2005 at Cairo. An early version of the principles set forth in this paper was the basis of a discussion by participants from the affected nations and supporting international institutions. Twelve principles were endorsed by the participants. Subsequently, guidance on how the principles can be implemented was distributed through the UNEP's Global Plan of Action. However, neither the nations affected by the tsunami nor the many national and international agencies contributing to the rehabilitation process have endorsed a common set of principles. The degree of coordination in each country varies widely. The golden opportunity to build on the best of what has been learned from the practice of integrated coastal management is slipping by; the unity of purpose and the success of the immediate response to an epic humanitarian disaster have not been sustained as competition for space on the shorefront once again becomes dominant.

## References and Notes

1. United States Geological Survey 2005. Earthquake Hazards Program. <http://earthquake.usgs.gov/eqinthenews/2004/usslav/>
2. CNN 2005. After the Tsunami. <http://edition.cnn.com/SPECIALS/2004/tsunami.disaster/>
3. New York Times. 2005. U.S. Nearly Triples Tsunami Aid Pledge, to \$950 million. February 10. <http://www.nytimes.com/>
4. Sorenson, J. 2000. Baseline 2000. Background Paper for Coastal Zone Canada 2000: Coastal Stewardship—Lessons Learned and Paths Ahead. September 17–22, New Brunswick, Canada. <http://www.sybertooth.ca/czc2000/>
5. Olsen, S.B. and Christie, P. 2000. What are we learning from tropical coastal management experiences? *Coast. Manag.* 28, 5–18.
6. Olsen, S. 1993. Will integrated coastal management programs be sustainable: the constituency problem. *Ocean Coast. Manag.* 21, 210–225.
7. Olsen, S.B. 2003. Frameworks and indicators for assessing progress in integrated coastal management initiatives. *Ocean Coast. Manag.* 46, 347–361.
8. Lee, K.N. 1993. Compass and Gyroscope: Integrating Science and Politics for the Environment. Island Press Washington, D.C. 243 pp.
9. Cicin-Sain, B. and Knecht, R.W. 1998. *Integrated Coastal and Ocean Management Concepts and Practices*. Island Press, Washington, D.C.
10. IWICM (The International Workshop on Integrated Coastal Management in Tropical Developing Countries). 1996. Enhancing the Success of Integrated Coastal Management: Good Practices in the Formulation, Design, and Implementation of Integrated Coastal Management Initiatives. MPP-EAS Technical Report No. 2, GEF/UNDP/IMO. Quezon City, Philippines. 32 pp.
11. World Bank. 1996. Guidelines for Integrated Coastal Zone Management. In: Environmentally Sustainable Development Studies and Monographs Series No. 9. Post, J. and Jundin, C. (eds.). The World Bank Washington, DC.
12. Chua, T.-E. 1998. Lessons from practicing integrated coastal management in South-east Asia. *Ambio* 27, 599–610.
13. GESAMP (IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). 1996. *The Contributions of Science to Integrated Coastal Management*. GESAMP Reports and Studies No. 61.
14. Holling, C. 1995. What barriers? What bridges? In: *Barriers and Bridges to the Renewal of Ecosystems and Institutions*. Gunderson, L.H., Holling, C.S. and Light S.S. (eds.), Columbia University Press, New York, 593 pp.
15. Lubchenco, J. 1994. The scientific basis of ecosystem management: framing the context, language and goals. In: *Ecosystem Management: Status and Potential*. Zinn, J. and Corn, M.L., (eds.). 103rd Congress, 2nd session, Committee Print. U.S. Government Printing Office, Washington, D.C. 33–39.
16. Olsen, S.B., Tobey, J. and Hale, L. 1998. A learning-based approach to coastal management. *Ambio*, 27, 611–619.
17. Sherman, K. and Duda, A.M. 1999. An ecosystem approach to global assessment and management of coastal waters. *Mar. Ecol. Prog. Ser.* 190, 271–287.
18. First submitted 4 Apr. 2005. Accepted for publication 20 June 2005.

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